

EXECUTIVE SUMMARY

Department of Commerce
NRC Inspection Report No. 07000398/2010001

A special inspection was initiated at the Gaithersburg, MD, facility on May 6, 2010, following the licensee's telephone report, on April 30, 2010, of a plutonium (Pu) contamination and improper transfer for disposal event that occurred on April 13-14, 2010. The licensee's telephone report of the event was not required by NRC regulation. Although violations of NRC requirements were identified, no significant personnel or offsite radiation exposure occurred as a result of the April 13-14, 2010, contamination and subsequent transfer of contaminated waste for disposal.

A second site visit included: (1) follow-up to the Pu event; (2) a full inspection of the NIST Gaithersburg licensed program; and (3) a review of progress in implementing the Confirmatory Action Order, dated March 1, 2010, issued to the Department of Commerce in response to a Pu contamination event at the NIST Boulder (Colorado) facility that occurred in June 2008. The Pu contamination at NIST Gaithersburg was much smaller in magnitude and hazard compared to the NIST Boulder Pu contamination, and consequences were much more limited.

Two violations of NRC requirements occurred as a result of the Pu event at NIST Gaithersburg: one violation of 10 CFR 20.1501(a)(2)(iii) for failure to perform the surveys necessary to comply with NRC regulations; and one violation of 10 CFR 20.2001 for disposal of contaminated materials by transfer to an unauthorized recipient.

REPORT DETAILS

I. Organization and Scope of the Program

a. Inspection Scope

The inspector examined the organizational structure of individuals responsible for management of radiation safety at the National Institute of Standards and Technology (NIST) at the Gaithersburg, MD campus. Also examined were the organizational controls implemented for safe use of radiation and radioactive materials.

b. Observations and Findings

Significant management changes had been made following the June 2008 plutonium (Pu) contamination event which occurred at the NIST facility in Boulder, CO. A new position of Chief Safety Officer had been created, and a new Radiation Safety Officer had been appointed. The licensee was also in the process of hiring additional radiation safety technical staff.

License SNM-362 authorizes a wide variety of materials and uses at the NIST Gaithersburg site and at temporary job sites under NRC jurisdiction. Licensed activities at the NIST Boulder site are conducted under a separate NRC license. The radiation safety program description document for Gaithersburg was recently revised and implementing procedures are generally being updated and revised, primarily as part of the corrective actions taken in response to the Boulder event. The RSO works with, and is part of, the facility Ionizing Radiation Safety Committee (IRSC), which reviewed and approved the new radiation safety program.

NRC issued Confirmatory Order EA-09-142, dated March 1, 2010, in response to the NIST Boulder event (ML100601095). The Order describes a number of actions required by the licensee at the Boulder and the Gaithersburg facilities. The inspector determined the licensee's status of implementing those corrective actions applicable to the NIST Gaithersburg license.

c. Conclusions

The licensee was making acceptable progress in implementing the committed changes to the radiation safety programs for license SNM-362 at NIST Gaithersburg, and was complying with the commitment milestones and due dates specified in the Order. The inspector concluded that the corrective actions taken in response to the Boulder event were not sufficiently implemented to be effective in preventing a different Pu contamination on April 13-14, 2010 at Gaithersburg.

II. Facilities and Equipment

a. Inspection Scope

The inspector toured the licensee's facilities at Gaithersburg with special focus on the facilities involved in the Pu contamination of April 13-14, 2010.

b. Observations and Findings

The May 6, 2010 site visit by the inspector was limited to an examination of the details and circumstances related to the Pu contamination of a laboratory in room 217/C115 on the NIST Gaithersburg campus. The inspection consisted of interviews of involved personnel, a tour of the impacted lab facilities at Division 837 of the Chemical Science and Technology Laboratory (CSTL), and an examination of the procedures and practices used.

On April 30, 2010, the licensee called the NRC to inform staff about a contamination event at Gaithersburg which occurred on April 13 and 14, 2010. While the licensee concluded the event was not reportable under the regulations in 10 CFR, the NRC was contacted by the RSO as a courtesy due to increased NRC interest in licensed activities at NIST because of the Confirmatory Order issued to the Department of Commerce/NIST on March 1, 2010.

When first obtained, the reference source involved in the April 2010 contamination was approximately 2.2 milligrams of Pu metal which was analyzed using a secondary ion mass spectrometer (SIMS). SIMS is a technique for analysis of solid materials which employs a beam of oxygen ions impacting the sample to "sputter" Pu ions off the surface, that then pass into the mass spectrometer. On May 6, 2010, the inspector examined the facilities and equipment involved in the April 13-14, 2010 Pu contamination. Licensee personnel involved in the contamination described to the inspector what happened, how contamination was identified, and their assessment of consequences. The licensee subsequently completed an investigation report of the event. A urine sample was collected from the impacted individual after radiation safety personnel were notified of detected contamination. The licensee sample was analyzed for bioassay of potential internal exposure to Pu. Urinalysis results showed no detectable activity present, indicating little or no radiation dose.

The licensee calculated that the SIMS analyses performed April 13-14, 2010, consumed ("sputtered" off) 8.1 micrograms (1.5 microCuries) of the Pu reference source. The licensee determined that most of the consumed Pu was deposited on a collection plate within the SIMS vacuum chamber, which was subsequently cleaned using a variety of methods. Ineffective contamination surveys were performed which did not identify any contamination. Cleaning procedures were therefore performed under the incorrect assumption that no Pu contamination was present. Routine precautions to maximize lab cleanliness were used, such as the wearing of rubber gloves and the covering of work tables with foil/disposable materials, which may have minimized the spread of

contamination.

When the SIMS collection plate cleaning was completed, other CSTL staff performed a sensitive survey and detected alpha contamination greater than the threshold requiring notification of Health Physics staff. CSTL personnel notified the Health Physics office and a detailed survey was performed. Measurements identified Pu contamination on the work table and in the lab sink. During the cleaning work, some water had been put into the sink and drained, and paper trash had been placed into normal (non-radioactive) trash. The licensee therefore assumed some contamination had entered the sanitary sewer and some contaminated trash had been disposed of in normal trash. The inspector reviewed the licensee's evaluation of the radiological impact of these releases. Sewer disposal was determined to be within the regulatory requirements of 10CFR20.2003 because of sufficiently small particle size and the limited radioactivity that could have been released via this pathway. Trash had already been removed from NIST by the time it was determined that contamination had been put into the trash. The licensee determined the likely disposal pathway for the contaminated trash was incineration along with the rest of NIST trash. Although only a fraction of the total Pu consumed in SIMS analysis would have been disposed of in trash, the licensee could not quantify how much was in the trash because the trash could not be retrieved and analyzed. The licensee therefore conservatively calculated a worst-case scenario in which the entire consumed sample of 8.1 micrograms was assumed to have been incinerated, and used this as the input source term for calculations.

The inspector evaluated the radiological impact from incineration of the trash using the NRC's RASCAL code for calculating potential dose from radiological releases. Using conservative assumptions, including the extreme assumption that 100% of the consumed source was placed into trash and incinerated, the dose to a maximally exposed individual within a mile of the incinerator was calculated as 2×10^{-5} mrem (2×10^{-3} mSv). Using similar assumptions, the licensee had estimated that a licensed release of this quantity of material (and neither NIST or the trash incinerator are licensed for such a release) would have been much less than the EPA permissible maximum emission requiring any reporting, which is 10 mrem (0.1 mSv). The inspector confirmed this conclusion based on independent calculations.

The licensee stated that April 2010 was the second time this Pu reference source was used in the SIMS at CSTL and the inspector also examined the first use, which occurred in July and August, 2004. Circumstances of that first use were similar to the April 2010 use except that no wash water was put into the sanitary sewer and the licensee calculated that about 10% as much Pu, or about 0.8 micrograms, was consumed. Personnel were unaware of the potential contamination at the time and it is possible that some contaminated trash was disposed of in 2004, although the amount of radioactive material would have been less than in 2010. Radiological consequences from the release of potentially contaminated trash in 2004 would be estimated to be no more than 10% of the 2010 occurrence described above.

The licensee took immediate corrective action following the April 2010 contamination to clean-up and contain the identified contamination (except for trash already removed from the facility and incinerated), and halted use of alpha-emitting radionuclides until the risks presented by their use are reviewed. These actions were intended to prevent recurrence

of similar unanticipated contaminations. The 2004 use of the source was not previously recognized as a potential contamination occurrence and no follow-up measurements were possible when the event was evaluated in May 2010. Evaluation of the 2004 occurrence was based upon the recollection of events by the personnel involved.

c. Conclusions

10 CFR 20.2001(a)(1) permits a licensee to dispose of licensed material only as specified, including only to an authorized recipient or for authorized disposal methods such as incineration permitted under specific conditions in 10CFR20.2004, which are not applicable to NIST in this case. Contrary to this requirement, following work on April 13-14, 2010, contaminated materials were included in normal trash, which was collected and transferred by the licensee's waste contractor to a commercial incinerator in Dickerson, MD. The trash collector and the incinerator operator are not authorized recipients licensed by the NRC or an Agreement State to dispose of radioactive material and therefore transfer of licensed materials to them in trash from NIST is a violation of NRC requirements. The inspector confirmed that the transfer of contaminated trash to an unauthorized recipient following the April 2010 event, and likely following source use in July-August 2004, appeared to be a violation of NRC requirements contained in 10 CFR 20.2001(a)(1). The inspector agreed with the licensee's conclusion that there were no significant radiological consequences to any member of the public as a result of this violation.

III. Training of Workers

a. Inspection Scope

The inspector reviewed the training program applicable to NIST users of licensed material, and specifically the training received by personnel involved in the April 2010 Pu contamination. Additionally, the inspector reviewed commitments identified in Confirmatory Order EA-09-142 related to training program improvements.

b. Observations and Findings

Training for CSTL personnel involved in the April 2010 event was current, was completed in 2008 as required by NIST procedures, and included the topics of contamination risks and controls. The licensee is in the process of significantly revising the training program for all NIST personnel and in particular for personnel who use radioactive materials. Training programs are being revised in response to the June 2008 Pu contamination in Boulder and Confirmatory Order EA-09-142. The licensee also plans to include in training information about the April 2010 Pu contamination at NIST Gaithersburg.

In response to Terms and Conditions (T&C) #3 of the Confirmatory Order, the licensee has developed a General Employee Training program in the format of computer-based training, intended to communicate general radiation safety policy and procedures to all incoming new employees. Delivery of the training began on June 29, 2010, and is ongoing until all personnel have been trained. Regarding T&C #4, detailed training for

personnel working with licensed materials is under development. Plans are to produce a 2-3 hour training course designed for all source custodians and radioactive materials users, which will also include details of the April 2010 Pu contamination event.

c. Conclusions

The licensee is making significant improvements to training programs in response to the June 2008 Pu event at Boulder, and is taking additional actions to directly address the human performance issues identified at Gaithersburg as a result of the Pu contamination in April 2010. No additional violations were identified.

IV. Radiation Surveys

a. Inspection Scope

The inspector reviewed the licensee's program for performing radiation surveys, including procedures, instruments, and personnel performance.

b. Observations and Findings

The licensee generally had procedures and instruments sufficient to enable adequate radiation surveys to be performed. The April 2010 Pu contamination, and the earlier Pu source handling in July-August 2004, provided examples of inadequate human performance of radiation contamination surveys, in which personnel used ineffective survey methods for the alpha-emitting contamination present. Additionally, the licensee had not sufficiently evaluated the hazards presented by use of the Pu reference source when the initial request to obtain it was made by CSTL.

Following use of the Pu reference source in the SIMS at CSTL on April 13-14, 2010, the user performed surveys with a ZnS alpha probe and a GM gamma probe. The ZnS probe may not have been positioned close enough to the Pu contamination to detect it, and the GM probe used subsequently may not have been sufficiently sensitive to detect the contamination. However, the manner in which the SIMS consumed the Pu source, "sputtering" the solid source to make it available in the SIMS vacuum chamber, should have been assumed to produce contamination based on the process of scattering the target source material. In this case it appeared the lack of measured radioactivity from the ineffective survey was considered as evidence that no contamination was present. Subsequently, a more sensitive survey performed by other CSTL personnel detected alpha contamination on lab surfaces greater than the radiation safety procedure action level, prompting notification of the Health Physics office. The Health Physics office then worked with CSTL personnel to perform a complete and comprehensive contamination survey to characterize the nature and extent of contamination.

Retraining of staff and implementation of a new, more comprehensive hazard analysis procedure are significant elements of the licensee's corrective actions to prevent recurrence of similar events in the future. The revised risk analysis will be expected to better evaluate the nature of radioactive materials requested for the type of use

proposed, prompting more vigorous review for more risk-significant materials. The licensee had begun to revise the risk analysis process in response to Confirmatory Order EA-09-142, T&C #6. A new procedure, HPI 4-15, "Radiological Hazard Review", became effective June 25, 2010. This procedure greatly expands the hazard review process and is being applied to all requests for new uses of radioactive materials. The licensee also plans to retroactively apply the new hazard analysis procedure to evaluate other existing uses of radioactive materials, and was evaluating all uses of Pu sources similar to that involved in the April 2010 event.

c. Conclusions

10 CFR 20.1501(a)(2)(iii) requires licensees to make surveys that are reasonable under the circumstances to evaluate the potential radiological hazards. Pursuant to 10 CFR 20.1003, "survey" is defined as an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation.

Contrary to these requirements, the licensee failed to make surveys necessary to assure compliance with the regulations in 10 CFR 20.2001(a), which limits transfer of licensed radioactive material to only authorized recipients. Specifically, the licensee did not adequately evaluate the hazards of utilizing the Pu reference source in the SIMS when its use was first proposed in 2004, and surveys of the SIMS and materials used to clean the SIMS on April 13-and 14, 2010, (and potentially following the first use of the Pu reference source in July-August 2004) were not sufficient or adequate to identify the Pu contamination present following use of the reference source. The failure to perform adequate surveys resulted in transfer of NRC-licensed material to unauthorized persons, and to unnecessary risk of radiation exposure by licensee employees.

V. Radiation Protection

a. Inspection Scope

Other routine radiation safety activities were reviewed as a part of this inspection. The inspector returned to NIST July 19-21, 2010, to complete a full safety inspection of the licensee.

b. Observations and Findings

The inspector reviewed the licensee's implementation of the National Source Tracking System (NSTS), using inspection procedure TI 2800/039. No unreported sources were identified. The inspector discussed with the licensee the additional information that could be reported on some of the listed devices, as well as the new reporting requirements contained within 10 CFR 20.2207. Also reviewed was implementation of NMMSS requirements, which are applicable to the licensee. Transaction records were examined and discussed with responsible personnel.

c. Conclusions

No additional issues or violations were identified.

Exit Meeting

An inspection exit meeting was conducted with licensee management at the NIST Gaithersburg facilities on September 15, 2010. NRC representatives discussed with licensee management the findings of the inspection and the identified violations. Licensee representatives acknowledged the violations and committed to make corrective actions to prevent recurrence.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

#*Tom O'Brien, CHP – Radiation Safety Officer, NIST

*Richard Kayser, Ph.D., Chief Safety Officer

Tim Mengers, Health Physicist, NIST

John Small, PhD, Division 837 Director, NIST

David Simons, Scientist, NIST

Albert Fahey, Scientist, NIST

Denotes individual(s) present at entrance meeting

* Denotes individual(s) present at exit meeting on September 15, 2010

ACRONYMS USED

CSTL	Chemical Science and Technology Laboratory
EPA	Environmental Protection Agency
IRSC	Ionizing Radiation Safety Committee
mrem	millirem
mSv	milliSievert (1 mSv = 100 mrem)
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
Pu	Plutonium
RASCAL	Radiological Assessment System for Consequence Analysis
RSO	Radiation Safety Officer
SIMS	Secondary Ion Mass Spectrometry